ESL-TR-99/12-10

Report of Energy Efficiency Study and Metering/Utilities Profile for Electricity Deregulation at the Prairie View A&M University (PVAMU) Prairie View, Texas

Submitted to

Prairie View A&M University
The Texas A&M University System

Submitted by

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Acknowledgement

The Electric Utility Regulation and Energy Efficiency Study for all universities in the TAMU System was initiated in May 1999 and is funded through an interagency agreement between the Chancellor's office and TEES's Energy Systems Laboratory. Detailed site visits were made to all system universities throughout the summer and fall. The Energy Systems Laboratory wants to thank all physical plant directors and their staff for their cooperation and support during the site visits.

Executive Summary

The physical plant director and staff at Prairie View A&M University (PVAMU) do a good job of maintaining PVAMU facilities and keeping expenses down. During our visit, however, we were able to identify several opportunities for improving energy efficiency.

Energy Savings Potential for Top Commissioning Targets

1. For top commissioning targets: about $80,000/yr, or 20% of the HVAC energy costs for these buildings. Campus wide, we feel the total energy savings will exceed $200,000 annually

Top Commissioning Targets Ranked by Potential Energy Savings

1. Library
2. New Office
3. Engineering Tech Building
4. W.R. Banks
5. Field House
6. Hobart Taylor Hall
7. New Gym
8. Administration Building
9. Engineering Complex
10. Education Building
11. Boiler Plant

Metering Recommendations for Electric Deregulation

Two options exist for the electrical data. #1 Install ESL meters or #2 purchase the utility interval data from San Bernard Electric Cooperative, Inc. If the energy efficiency study is pursued, then hourly gas data will also be necessary. Our recommendation is to use the ESL metering system and meter both the total gas and total electrical consumption for the campus

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Energy Efficiency Study

General Introduction

The Prairie View A&M University campus is located in Prairie View, Texas. The weather is typical for south central Texas, hot in the summer and mild in the winter.

There are a total of 70 buildings with approximately 1,840,000 square feet of building area on the campus. Most buildings are served by central air conditioning.

The electricity and gas costs for 1998 were $1,879,792 and $449,983 respectively. This translates to about $1.27/yr/ft^2 for all of the buildings on the campus.

Five 1100 ton chillers are located in the central plant and provide the chilled water to the campus loops. Four boilers are installed in the central plant with the capacity to provide 122,000 lb/hr of steam. These include one 50,000lb/hr, two 25,000lb/hr and one 22,000 lb/hr boilers. There is a total of five 150 hp, constant volume pumps, serving the chillers and the loops. There is no secondary loop in this plant.

The HVAC systems in three buildings (W.R. Banks, Memorial Student Center, and Alumni Dining Hall) are fully controlled by a Johnson Controls Metasys direct digital control (DDC) system. The HVAC systems in other buildings are controlled by a Johnson Controls JC-8540 system. As building HVAC systems are replaced or when their budget allows, the controls are also being upgraded to the full DDC control level. A new Science building is under construction and will be on line sometime during year 2000. Two dorm buildings were vacant during our trip and will be demolished soon. The Memorial Student Center building and Alumni Dining Hall will be demolished in the near future, according to the plant operator.

From September 21 to September 23, 1999, engineers from the Energy Systems Laboratory conducted a commissioning survey for the campus. A total of 16 major buildings, and the central plant were visited during the trip. The major buildings were surveyed in detail and measurements were also performed for most air-handlers and pumps. The outside air temperature varied from 60°F to 85°F during the 3 day visit.

Based on our survey results, the general mechanical systems seem to be well maintained. However, several energy saving potentials were identified and several mechanical problems were discovered as well. The following is a summary of the results of the commissioning survey.

The layout of PVAM University campus is shown in Figure 1.

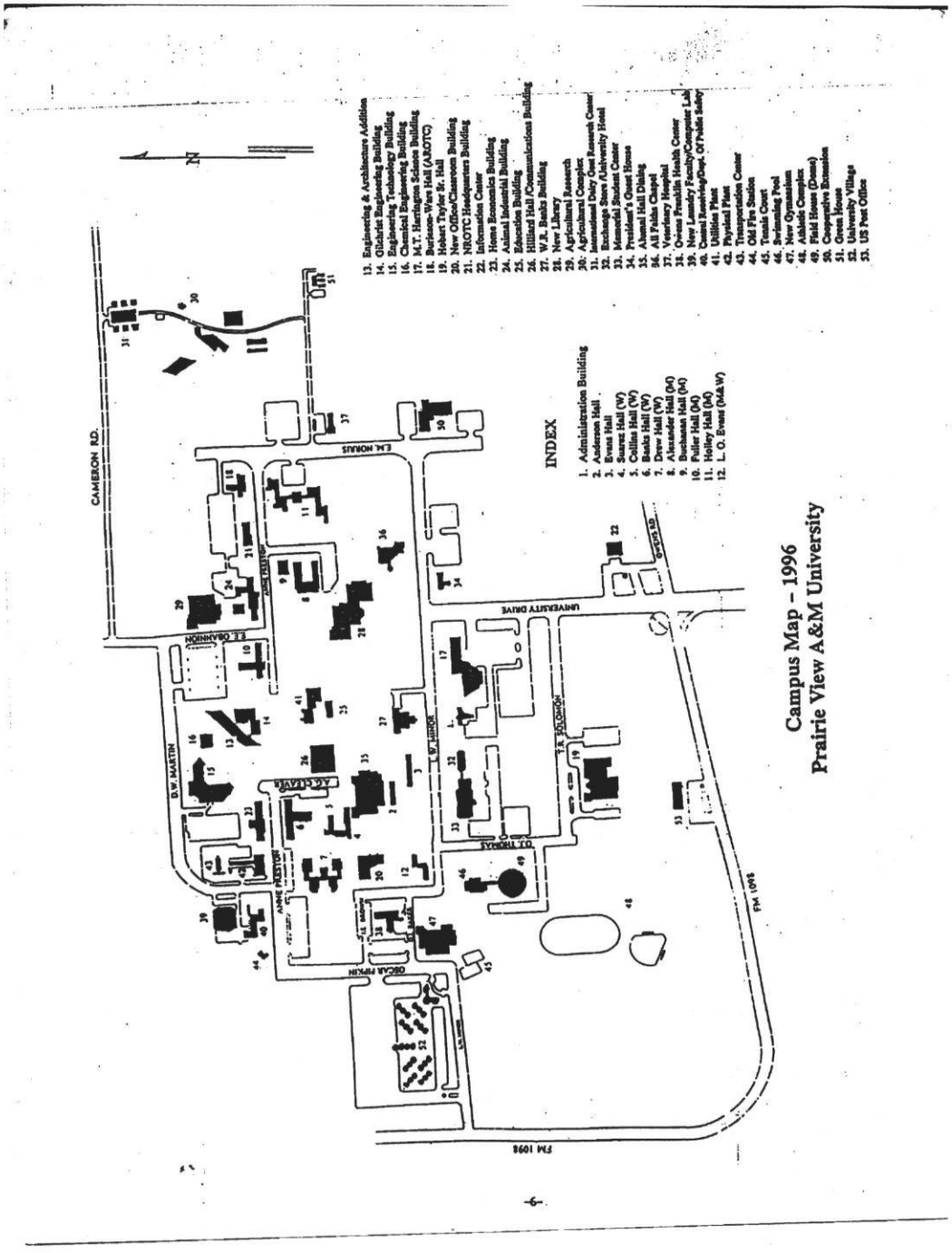

Figure 1. The PVAM University Campus and Buildings

Energy Savings Potential and Top Commissioning Targets

Energy Savings Potential for Top Commissioning Targets

1. For top commissioning targets about $80,000/yr, or 20% of the HVAC energy costs for these buildings. Campus wide, the energy savings for the entire campus should exceed $200,000 annually.

Commissioning Targets Ranked by Potential Energy Savings

1. Library
2. New Office
3. Engineering Tech Building
4. W.R. Banks
5. Field House
6. Hobart Taylor Hall
7. New Gym
8. Administration Building
9. Engineering Complex
10. Education Building
11. Boiler Plant

Summary of Building Information and Major Recommended Energy Measures

Education Building (offices, classrooms)

Building Information
This is a 3-story building with an area of 37,000 ft^2. The HVAC systems are controlled by the Johnson Controls- 8540 system.

The building receives chilled water and steam from the central plant. The hot water pump was off at the time of the visit. The on/off controls of the hot water pumps is based on the outside air temperature. The chilled water pump was on during the visit.

Two single duct variable air volume (VAV) (SDVAV) AHUs serve the building. The variable frequency drive (VFD) speeds were 85% for the two units. The discharge temperatures were 59.5°F for both units. There was very little outside air intake for this building.

Recommended Energy Measures

1. Reset the discharge air temperature setpoints.
2. Reset static pressure schedule based on the VAV box condition.
3. Optimize system operating schedule based on the occupancy schedule.

Administration Building (offices)

Building Information
This is a 1-story building with a conditioned area of 15,408 ft^2. The HVAC systems for this building are controlled by the JC 8540 system.

The building receives chilled water and steam from the central plant. The 15 hp hot water pump was on. The chilled water pump was running at 98% speed. The setpoint of differential pressure for chilled water loop was 35 psi. The hot water pump is controlled based on outside air temperature. The outside air temperature was 86.4°F at the time of the visit.

Two single duct VAV AHUs with reheat (SDVAV) and two single duct constant volume (CV) AHUs serve the building. The static pressure setpoints were 1.5 in H2O for the two VAV units. The space setpoint was 66°F for the CV units. The VFD speeds were 82% and 93% for two VAV units. The cold deck temperatures were 54°F to 56°F for the two units. The outside air intake was over 50% for AHU-3.

Recommended Energy Measures

1. Adjust the room temperature setpoints for the areas served by AHUs-1 and 2.
2. Reset differential pressure setpoint for the chilled water loop.
3. Change reset schedule for hot water pump.
4. Reset static pressure and cold deck temperature setpoints for VAV AHUs.
5. Optimize outside air intake for AHU-3.
6. Optimize the system operation schedule based on the occupancy schedule.

Engineering Complex (offices, classrooms)

Building Information
This is a 2-story building with an area of 63,268 ft^2. The HVAC systems are controlled by the JC 8540 system.

The building receives chilled water and steam from the central plant. Two hot water pumps were off. The two 15 hp chilled water pumps were both on and were running at 52% speed.

Nine single zone AHUs and two single duct VAV AHUs serve the building. The speeds for VAV AHUs-1 and 2 were 80% and 100%. The outside air intake was about 10% for AHU-2.

Recommended Energy Measures

1. Reset differential pressure for chilled water loop.
2. Optimize the on/off control for the two hot water pumps.
3. Reset the static pressure setpoint for two VAV AHUs.
4. Optimize the system operation schedule based on the occupancy schedule.

Engineering Tech. Building (offices, classrooms, labs)

Building Information
This is a 3-story building with an area of 78,945 ft^2. The HVAC systems are controlled by the JC 8540 controller.

The building receives chilled water and steam from the central plant. The 7.5 hp hot water pump and 20 hp chilled water pump were on. 5 hp chilled water pump was off. The hot water supply and return temperatures were 134°F and 120°F during the visit. The differential temperature for chilled water was 5°F based on the local temperature sensors.

A total of seven single duct VAV AHUs serve the building. The VFD speeds ranged from 78% to 100%. The static pressure setpoints were from 1.0" to 1.5". The discharge air temperature setpoints were from 53°F to 55°F with actual measured results from 49.8°F to 56.9°F. The air pressure dropped by 0.5" through the filter of AHU-1. Based on the measured results, the outside air intake was over 50% for AHUs-5 & 6.

Recommended Energy Measures

1. Reset static pressure setpoints for all units.
2. Reset discharge air temperature setpoints for all units.
3. Change the filter regularly for the AHUs.
4. Optimize the outside air intake for the AHUs based on the ASHRAE standard.
5. Optimize the system operation schedule based on occupancy schedule.

John B. Coleman Library (library, book stacks, offices)

Building Information
This is a 5-story building with an area of 150,748 ft^2. The HVAC systems are controlled by the JC 8540 controller. Currently, it is the largest building on the campus. The ESL team visited this building on September 22 and 23.

The building receives chilled water and steam from the central plant. Two chilled water pumps are equipped with VFDs. Two constant volume hot water pumps were off line during the visit. Seven single duct VAV AHUs and seven multi-zone AHUs serve the building. The static pressure setpoints were 0.5" or 0.6" for all the VAV AHUs. The cold and hot deck setpoints were 55°F and 70°F for all the units. The fan speeds were from 18Hz to 33Hz for most AHUs, but it was 60Hz for AHU-14 only. At the time of the visit, the outside air temperature was about 64°F. The preheat was on for AHUs-1 & 5. The space temperature was 64°F for the 5^{th} floor and part of the 4^{th} floor.

The chilled water pumps were all off line due to testing of the piping system the for New Science building during the first visit. The cold deck temperatures and discharge air temperatures were 63°F to 71°F for the four AHUs checked on this visit. During the second visit to the building, one chilled water pump was online and running at 59%. The cold deck and discharge air temperatures were decreased to the range of 54°F to 59°F. The cold deck temperatures of 5

AHUs were 52°F or lower. These results indicate a problem with chilled water balance and control in this building.

Recommended Energy Measures

1. Adjust the room temperature from the current setpoints on the 5th and 4th floors.
2. Reset the cold deck discharge temperature setpoint with schedules for all units.
3. Reset static pressure setpoints for SDVAV units.
4. Modify the control of preheat for the AHUs.
5. Balance the chilled water loop and reset control setpoint for chilled water loop.
6. Modify on/off control of hot water pumps.
7. Balance the multi-zone units.

Harlington Science Building (offices and classrooms)

Building Information

This is a 3-story building with a conditioned area of 38,198 ft^2. The HVAC systems are controlled by the JC 8540 controller.

The building receives chilled water and steam from the central plant. One chilled water pump and one hot water pump were on.

Five multi-zone AHUs and one pretreat unit serve the building. The measured cold and hot deck temperatures were 62°F and 81.5°F. The mixed air temperature was 75.2°F. The outside air intake was about 50%.

Recommended Energy Measures

1. Optimize the outside intake.
2. Reset cold and hot deck setpoints.
3. Balance the zones.

Hilliard Hall (offices and radio stations)

Building Information

This is a 2-story building with an area of 38,346 ft^2. The HVAC systems are controlled by the JC 8540 controller.

The building receives chilled water and steam from the central plant. One of the two chilled water pumps and one of the two hot water pumps were on during the visit. All the pumps are constant volume.

The AHU-1 (50 hp) was running with 53.8°F cold deck and 92°F hot deck, while mixed air had a temperature of 74.8°F. The AHU located in the basement was running with 56°F cold deck and 78.8°F hot deck and 76.5°F mixed air temperature.

Some rooms were found to have noticeable indoor air quality problems, bad odors and high RH. This should be investigated in detail. Most of the mechanical systems are in poor condition.

Recommended Energy Measures

1. Solve the IAQ problems.
2. Optimize the operating schedule for the hot water pumps.
3. Optimize the cold deck and hot deck setpoints
4. Balance the chilled and hot water loops.

Alumni Dining Hall (kitchen area, dining area, offices and warehouse)

Building Information

This is a 2-story building with an area of 117,732 ft^2. The HVAC systems are controlled by the JC Metasys system.

The building receives chilled water and steam from the central plant. The hot water pump was off at the time of the visit. One chilled water pump was on. All the pumps are constant volume.

At least seven multi-zone AHUs and several SDCV AHUs serve the building. The cold deck temperatures were from 54°F to 64°F. The hot water was not supplied to the AHUs at the time of the visit. The building had very little outside air intake. Most AHUs and pumping systems are in poor mechanical condition. According to the plant staff, this building will be demolished soon. The system had a shutdown schedule from to 8:00 p.m. to 5:00 a.m.

Recommended Energy Measures

1. If this building will be demolished soon, there are no recommendations.
2. If this building will last for another year or longer, the mechanical systems conditions need to be improved. Then, the water loop and air system needs to be balanced and the deck temperatures need to be reset.

MSC Building (offices, student activities, barber, dining areas, kitchen)

Building Information

This is a 2-story building with a conditioned area of 24,588 ft^2. The HVAC systems are controlled by the JC Metasys system. The entire building includes the MSC section and a small section of JCPC.

The building receives chilled water and steam from the central plant. The hot water pump was on at the time of the visit. One chilled water pump was also on. All the pumps are constant volume.

A total of five SDCV AHUs serve the MSC section and one multi-zone unit serves the JCPC section. The discharge air temperatures were found to vary from 53°F to 66°F for different AHUs. There was little outside air intake for the building. The system had a shutdown schedule from to 11:00 p.m. to 5:00 a.m.

According to the plant staff, this building will be demolished soon also.

Recommended Energy Measures

1. If this building will be demolished soon, there are no recommendations.
2. If this building will last for another year or longer, then, the water loop and air system need to be balanced and the deck temperatures need to be reset. The hot water system operating schedule needs to be optimized.

Field House (gym, locker rooms and swimming pool)

Building Information
This is a 1-story building with a conditioned area of 67,594 ft^2. The HVAC systems are controlled by the JC 8540 controller.

The building receives chilled water and steam from the central plant. Two hot water and two chilled water pumps were both on. All the pumps are constant volume.

A total of 18 SDCV AHUs and 5 fan coil units (FCUs) serve the gym areas. More than seven SDCV AHUs serve the locker rooms and hallway. At the time of the visit, there was a job fair in the gym. The space temperatures were from 67°F to 68F for the entire gym area. More than 50% of the AHUs were on line and some others were scheduled off line. The eighteen AHUs which serve the gym areas are 100% outside air units. Due to the limited time, only a few AHUs were inspected.

Recommended Energy Measures

1. Optimize the operating schedule of the AHUs for the gym area.
2. Adjust the room temperature setpoints.
3. Optimize the operating schedule of AHUs for the locker rooms and hallway.

W.R. Banks (offices and classrooms)

Building Information
This is a 3-story building with an area of 57,225 ft^2. The HVAC systems are controlled by the JC-Metasys system.

The building receives chilled water and steam from the central plant. The hot water was off. The variable speed chilled water pump was on with a manual setting of 100%.

A total of nine SDCV AHUs serve the building, three on each floor. The discharge air temperatures were 54°F and lower for 5 AHUs. The outside air intakes for AHUs-1-3, 1-2, 3-3, 3-2 were over 50%. The systems had a shutdown schedule from to 8:00p.m. to 4:30 a.m.

Recommended Energy Measures

1. Optimize the chilled water differential pressure setpoint.
2. Optimize the hot water system operating schedule.
3. Optimize the operating schedule of AHUs.

4. Optimize the outside air intake for the AHUs.
5. Reset discharge air temperature for the AHUs.

New Gym (gym)

Building Information
This is a 1-story building with an area of 100,769 ft^2. The HVAC systems are controlled by the JC 8540 system.

The building receives chilled water and steam from the central plant. The hot water pump was off. The variable speed chilled water pump was running at speeds between 78% to 100%. The manual chilled water valve was partially open. The differential pressure setopint was 15 psi. The system had a shutdown schedule from to 10:00 p.m. 4:00 a.m.

A total of seven SDCV AHUs serve the building. Two large SDCV units serve the gym area. The space temperature was 69.6°F for the gym area with no occupancy. Three SDCV AHUs serve racquetball rooms. Ahu-5 was off line due to a chilled water line problem.

Recommended Energy Measures
1. Optimize the operating schedules for the AHUs.
2. Reset the discharge air temperature setpoints.
3. Reset the chilled water differential pressure setpoints and balance the loop.
4. Tune the control for the chilled water VFD.

New Office or General Office (offices, classrooms)

Building Information
This is a 3-story building with an area of 58,422 ft^2. The HVAC systems are controlled by the JC 8540 system.

The building receives chilled water and steam from the central plant. The hot water pump was running at 70% speed. The chilled water was running at 100% speed. The chilled water differential pressure setpoint was 20 psi.

A total of six SDVAV AHUs with terminal reheat serve the building. The cold deck temperatures were from 53°F to 56°F. The VFD speeds ranged from 73% to 84%. The outside air intake was over 50% for AHU-1. There was little outside air intake for other units. The static pressure setpoints were 0.5" for the AHUs.

Recommended Energy Measures
1. Optimize the operating schedules for the hot water system.
2. Reset the cold deck temperature setpoints.
3. Reset the chilled water differential pressure setpoints and balance the loop.
4. Optimize static pressure setpoints for the AHUs.

Hobart Taylor Hall (offices, classrooms, band hall)

Building Information
This is a 2-story building with an area of 100,158 ft^2. The HVAC systems are controlled by the JC 8540 system.

The building has its own chiller and boiler. The capacity of the boiler is 2.5MMBtu/hr. During the visit, the boiler was on. The chiller supplies 50°F chilled water to the building. The chilled water and hot water pumps are constant volume.

A total of nine multi-zone AHUs serve the building. There is no hot deck for the multi-zone units. A hot water reheat coil is installed in each zone. The cold deck temperatures ranged from 52°F to 58°F. The out side air dampers were open for AHUs-8 & 9. Some zone dampers were disconnected for AHU-7.

Recommended Energy Measures

1. Optimize the boiler and hot water pump operating schedule.
2. Optimize the cold deck setpoints.
3. Reset the chilled water differential pressure setpoints and balance the loop.
4. Balance the zones.
5. Optimize the outside air intake for AHUs-8 & 9.
6. Optimize the system operating schedule for the AHUs.

Summary of Plant Information and Major Recommended Energy Measures

There are 4 boilers located in the central plant, two 31 MMBtu/hr boilers, one 25 MMBtu/hr boiler. According to the operator, the boiler is run at 150 psi most of the time.

There are five 1100 chillers located in the central plant. Two Carrier chillers are approximately 20 years old, one Trane chiller is approximately 10 years old, and two Trane chillers are newly installed. Five constant volume primary pumps provide the chilled water to a common header, which feeds all five chillers. There is no secondary loop in the plant. At the time of the visit, with an outside air temperature of 80°F, three chillers were manually turned on to generate the chilled water to the campus loop. The chilled water supply temperature setpoint was 42°F with actual temperature of 47°F.

Recommended Energy Measures

1. Optimize the steam pressure setpoint for the boiler.
2. Optimize the differential pressure for the chilled water loop.

Electricity Deregulation Metering Options

Whole Campus Metering

The PVA&M campus main electricity feed is located on the east side of campus near the Holly Hall, which will be demolished soon. The main gas feed is located two miles away from the campus.

Metering Options

Option 1:
Install ESL metering and poll data from College Station. This installation would share the pulse signal from the utility company. An ESL data logger would have to be installed for the electrical signal. For the gas signal, a pulse initiator would have to be installed and a remote transmitter would need to be installed to get the gas signal. It might be necessary to install a second data logger because of the remote location of the gas meter.

Since PVA&M will likely not be able to participate in the utility deregulation in 2001 or 2002, the metering would only be necessary for the energy efficiency study. However, PVA&M is a good candidate for building commissioning, and meters are recommended.

Option 2:
Buy interval data from the electric co-op and install a pulse initiator on the gas line. Use electric utility data from the co-op and poll the gas data from College Station. This option is not recommended.

Utility Bill Summary

Prairie View A&M University									
Month	Energy-kWh	Energy Costs $	Demand-kW	Demand Costs $	PCRF& Other Adj.	Gas MCF	Gas Costs $	Tol.Elec costs	Total costs
Jan-98	2864830	103732	5840	34257	-5763	20317	63455	132226	195681
Feb-98	3088090	111467	5860	31903	-12364	19824	56845	131007	187852
Mar-98	2719810	98708	5310	27224	-6785	19177	60103	119147	179250
Apr-98	3215680	115887	6000	42100	-8729	13845	45685	149259	194943
May-98	3071030	110876	6000	42100	-7930	9191	30013	145046	175059
Jun-98	3576630	128392	6670	42427	16117	7309	22189	186936	209125
Jul-98	3552480	127556	6160	38928	12657			179141	179141
Aug-98	3672870	131727	6760	46064	18064	7916	23322	195854	219176
Sep-98	3871610	138612	6920	46950	17823	7844	20428	203384	223813
Oct-98	3541030	34740	6330	17408	107902	10279	31231	160049	191280
Nov-98	3369630	33271	6220	17105	99565	14803	42883	149941	192824
Dec-98	2949630	29672	6400	17600	80529	18825	53828	127802	181630
Tol/Max	**39493320**	**1164639**	**6920**	**404065**	**311087**	**149330**	**449983**	**1879792**	**2329774**
Electricity Provider: San Bernard Electric Cooperative, Inc.									
Gas Provider: Texas Southeastern Gas									